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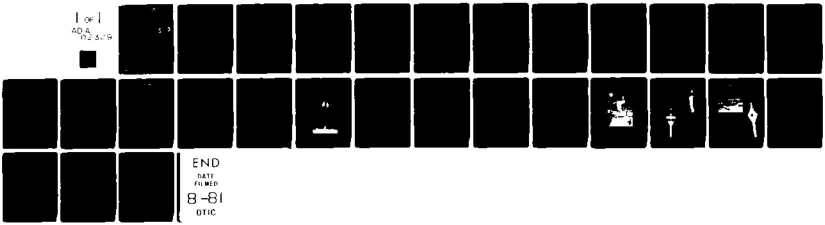

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AUSTRALIAN OCEANOGRAPHIC DATA CENTRE

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FOREWORD

The Australian Oceanographic Data Centre is gradually expanding its activities and capabilities in an effort to become more involved in the Australian marine science community. This and subsequent Bulletins are intended to be a medium through which communication between oceanographic organisations can take place by providing information and details of present marine activities.

The initial response to the questionnaire included in the AODC Newsletter, January 1980 was poor but we are anticipating that more will be completed and returned as time permits. The results from these along with ROSCOP will form the basis of an inventory on Australian oceanographic research.

A proposed re-organisation of the Hydrographic Service which will result in this office assuming responsibility for meteorology and oceanography within the Navy should enable the AODC to play a much more active role than present. Past problems that have been caused by a severe limiting of manpower and resources should be overcome.

The AODC would welcome any contributions, in the form of articles or papers on any research project or oceanographic topic to be included in future Bulletins.

I thankyou in anticipation of your co-operation in the above matters.

(M. CALDER)
Captain, RAN
DIRECTOR, AODC

AODC BULLETIN

CONTENTS

INDIAN OCEAN

In accordance with the requirement to hold oceanographic data on all the sea areas continguous to Australia the AODC is now in the process of acquiring data to cover the Indian Ocean.

A request for bathythermal and ocean station data to supplement the small amount of existing data for the area from the Asian continent to the Antarctic has been passed to the United States National Oceanographic Data Centre. During the next few months work will be carried out to develop this into a working data base utilising the existing retrieval system plus any new analytical programmes developed during the interim. This data bank will have numerous applications to all users and substantially increase the AODC's data holdings.

BATHYTHERMAL DATA BANK

The Bathythermal Data Bank is continuing to expand at a satisfactory rate. As of 1st April 1980 the number of XBT and MBT observations totalled 80,221. The increase has resulted from Royal Australian Navy bathythermograph observations that have been processed and digitised on the AODC's digitising facilities over the past few months. Continued international exchange has provided an additional 18,500 observations. This data will be added to the data bank once checks have been conducted on duplication with existing data and sorting into areas has taken place.

Liaison with various organisations within Australia has resulted in the AODC uncovering several thousand XBT observations that have not yet been digitised. This data will be requested from these organisations when time and resources permit the processing and digitisation of these traces.

A data base developed from temperature sensors lowered from helicopters has recently been started. To date over 200 observations have been digitised by personnel from 817 Squadron, NAS NOWRA. The co-operation and assistance provided by 817 Squadron in starting this new data bank is greatly appreciated.

The AODC is encouraged by the continuing improvement in the observations taken by the RAN Fleet. The accuracy and care taken in completing the important Log Information has reduced the number of traces rejected for digitising. This improvement is significant when considering the expense of the bathythermograph probes and the use to which the resulting data is put.

All civil collectors of bathythermal data who are not yet doing so are requested to make any data available to the AODC for addition to the National Data Bank.

Data Requests

The Newsletter (January, 1980) has resulted in a wider range of marine science organisations becoming aware of the AODC's capabilities and activities. Requests for bathythermal data have come from an increasing number of agencies.

These include –

(a) CSIRO, Division of Fisheries and Oceanography (Coral Sea)

(b) Department of Primary Industries, Resource Management Section, Fisheries. (North West Shelf, Bass Strait).

(c) Department for the Environment, Adelaide (St. Vincents Gulf).

The AODC continues to supply Navy with data as required.

While the AODC maintains only a bathythermal data bank at this stage it does have access to a variety of oceanographic products and data parameters produced for the IOC by various National Oceanographic Data Centres. Organisations that require data other than bathythermal should not hesitate in contacting the AODC. Every effort will be made to fulfil the request from national or international agency sources or a contact point will be provided.

OCEAN STATION DATA

The AODC is expanding the range of oceanographic data parameters to be acquired and archived in an attempt to provide a wider service to the marine science community. A request has been forwarded to the U.S. National Oceanographic Data Centre for an ocean station data file covering the AODC's area of interest. This file will contain various data parameters and it is intended to produce retrieval and analytical programmes to display this data in the variety of forms similar to those currently available with the bathythermal data bank.

The ocean station data file will contain primarily Nansen cast observations which will be supplemented by salinity – temperature – depth (STD) data. The data held in this file will include –

1.	Temperature	degrees centigrade
2.	Salinity	parts per thousand
3.	Sigma–T	sea water density anomaly
4.	Dynamic depth	dynamic depth anomaly in dynamic metres to millimetress
5.	Sound velocity	metres per second according to Wilsons Formula
6.	Oxygen	
7.	Inorganic phosphate	
8.	Total phosphorous	
9.	Nitrates	
10.	Silicates	
11.	pH	
12.	Meteorological information	

The structure of the ocean station file is similar to that of the AODC bathythermal data bank with the header sequence providing details such as location and time and date of observation. The observed or interpolated data is then listed for specific depths. An explanation of the data listing is also available if required.

INTEGRATED GLOBAL OCEAN STATION SYSTEM (IGOSS)

IGOSS is an international programme co-sponsored by the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the World Meteorological Organisation (WMO). The purpose of IGOSS is to provide a world wide system for the rapid collection, exchange and analysis of oceanographic data and the preparation and dissemination of ocean products and services.

Australia, an original member of IOC, has been providing data to IGOSS for some years. Recent contributions include —

1. Bureau of Meteorology involved with the 300 buoy Southern Hemisphere Drifting Buoy System (refer to page **7** for a more complete explaination).
2. Bureau of Meteorology; Royal Australian Navy; CSIRO, Division of Fisheries and Oceanography and the RAN Research Laboratory were all involved in the First GARP Global Experiment (FGGE). HMAS DIAMANTINA was deployed in the Indian Ocean as a Tropical Wind Observing Ship during the intensive special observing period (10th May to 8th June, 1979). The AODC holds the reports of the Australian contribution to this experiment.

BATHY/TESAC

The first observational system established by IGOSS was the BATHY/TESAC programme. This involves the world-wide collection, exchange and processing of BATHY data (profiles of ocean temperature versus depth) and TESAC data (temperature/salinity/current versus depth). Ships from many nations contribute data and the 'real-time' exchange of data has increased by 500% since the programme was established in 1972. The data and some of the products are exchanged over a high-speed global telecommunications link called the Global Telecommunications System (GTS). This system is provided by the WMO. The data is compiled into concise data bulletins at regional, national and world meteorological centres and enters the GTS for global exchange.

To date the Australian contribution to the BATHY/TESAC programme has consisted primarily of non 'real-time' transmission of BATHY data. This data is exchanged with other national oceanographic data centres, specifically World Data Centre A, Washington and the U.S. National Oceanographic Data Centre on a non regular basis. However, through liaison with the Bureau of Meteorology, CSIRO (Division of Fisheries and Oceanography) and the Royal Australian Navy steps are being taken to implement the transmission of BATHY data on a 'real-time' basis. This will be of considerable value to both the Australian and international marine community. The area surrounding Australia has always been considered data sparse, especially for real-time data and at present the major source of data is provided by satellite and drifting buoys. A large increase in data for the Australian area will provide the national oceanographic data centres producing IGOSS products with more accurate information. The resulting products, which include sea surface temperature, layer depth, temperature anomalies and ocean front analysis, will be available to Australian users through IGOSS. It is anticipated that over 2,000 observations will be transmitted each year to IGOSS via GTS from Australian sources.

Any organisation requiring more information on IGOSS and the various products and services available should contact the AODC.

REPORT OF OBSERVATIONS/SAMPLES COLLECTED BY OCEANOGRAPHIC PROGRAMMES (ROSCOP)

ROSCOP is intended to be a new mechanism in support of international data exchange and lead to a better understanding of the location and type of data collected by Australian marine organisations. The forms will provide the basis of an inventory of data and samples collected during oceanographic cruises. The AODC will supply the forms to all interested research organisations undertaking cruises and archive the results including a summary of them in future AODC Bulletins. Copies of the forms will be forwarded to World Data Centre, A (Oceanography) in Washington, USA to be used in a world wide marine data referral system.

The Victorian Institute of Marine Science has already completed forms for five cruises and CSIRO, Division of Fisheries and Oceanography will be using ROSCOP forms of forthcoming cruises on the 'SOELA' and 'SPRIGHTLY'.

It is apparent that communication between marine research agencies in Australia has not been good and a knowledge of research being undertaken by neighbouring groups is often poor. The AODC is attempting to reverse this situation and believes that participation in ROSCOP is a useful step in this direction. Any organisation that wishes to become involved in this scheme can obtain ROSCOP forms directly from the AODC.

The ROSCOP forms contain general information on the oceanographic research conducted during cruises such as the area in which the work was carried out, where the data is finally stored and the time period of the cruise. Specific data parameters and samples collected are covered in the following six sections.

1. Meteorology
2. Hydrography
3. Pollution
4. Geology Geophysics
5. Dynamics
6. Biology

H.M.A.S. COOK

The Royal Australian Navy's new ship H.M.A.S. COOK is a specially designed oceanographic research ship capable of being employed on oceanographic tasks and limited hydrographic surveys for long period, anywhere in the Australian sphere of marine interest.

COOK is 96.5 metres in length with a beam of 13.5 metres and a displacement of 2540 tonnes. Propulsion will be provided through four diesel engines driving controllable pitch propellers, giving the ship a range of 11,000 miles at its general operating speed of 14 knots. The ship is stabilised by a passive tank system. Accommodation is available for up to 13 scientists in single and double berth cabins.

Apart from the oceanographic laboratory and wet laboratory, there also exists a data centre housing the data logging computer, a number of chart recorders and two incremental plotters. The computer itself is a Hewlett Packard 1000 Model 40E series system with 256 kilo byte core memory and a 19.6 mega byte disc system.

The ships main sensors include —

1. Satellite navigation and ARGO precision navigation systems.
2. Stabilised narrow beam echo sounder system.
3. Plessey Ocean Profiling System (6000m depth).
4. Expendable Bathythermograph (depth to 1850 metres)
5. Data well wave rider buoys.
6. Thermosalinograph.
7. Sea surface temperature, engine inlet and hull.
8. Radiation shortwave/all wave.
9. Radiosonde.
10. Meteorological sensors — wind, air temperature and air pressure.

It is expected that H.M.A.S. COOK will commission in late 1980 and be available for full oceanographic cruises by mid 1981. Agencies interested in obtaining ship time should make initial enquiries to the Hydrographer, RAN.

A BRIEF REPORT ON AUSTRALIA'S PARTICIPATION IN THE FGGE SOUTHERN HEMISPHERE DRIFTING BUOY SYSTEM

INTRODUCTION

Australia's commitment to the 300 buoy Southern Hemisphere Drifting Buoy System was to provide and deploy 50 buoys and to carry out quality monitoring of the observations for the complete network. The network, including the Australian component, has been very successful in spite of its technical novelty and the short time available for implementation. 120 buoys, including 20 Australian, were still operational in late January 1980 however they are expected to expire due to battery exhaustion by mid 1980. (As of 31 May 1980 57 buoys including 10 Australian were still operational).

This report provides a summary covering the Australian participation in the program, together with current WMO and Australian developments. More detailed information is available in the preprints of the Australia—New Zealand GARP symposium held in December 1979 in Melbourne.

BACKGROUND

In October 1976 the Australian Government approved a $350,000 program in the 1976—79 time period to enable Australian participation. Executive responsibility for its implementation was given to the Bureau of Meteorology which established a project team led by its Superintending Engineer, R.S. de la Lande. International planning and co-ordination was carried out by a WMO Committee of Participants which included representatives from Argentina, Australia, Canada, Chile, France, New Zealand, Norway and, more recently, USSR. The Committee's work involved the development of an Implementation/Operations plan covering technical standards, deployment, data dissemination, quality monitoring, etc.

IMPLEMENTATION

Australia's 50 buoys, based on a successful experimental model developed by the Bureau using a CSIRO hull, were manufactured by Australian industry except for several specialised imported components such as the pressure sensor and transmitters. The actual cost of the program was slightly less than the amount approved. Although the program was successful, the delayed launch of the TIROS N satellite was a problem in that it prevented the operational testing of the buoy design until late in the production program.

Australia's deployment responsibility broadly covered the area from 70° East to 180° East longitudes. The Australian buoys were deployed by Antarctic re-supply ships and some 20 merchant vessels as incidental activities on their normal routes. Other participating countries used dedicated ships as well as the above type of vessel for their deployment programs. In May 1979, 18 parachute deployable buoys developed by the United States were deployed by their airforce. These included 7 used to fill gaps in the network south of Australia at the Bureau's request (Bureau officers participated in this mission).

Altogether 47 Australian program buoys were deployed. The remaining 3 were not deployed because of the need to retain one for development and because of last minute deployment or technical problems. Australian deployments were carried out from 8 November 1978 to 28 May 1979.

PERFORMANCE

Buoys

On 30 November 1979 which was the end of the Experiment's operational year, 20 of Australia's 47 buoys were operational. On 31 January 1980 the 20 were still operational and included 15 with lifetimes in excess of one year, the longest being 446 days.

In general the performance of the buoys deployed under the Australian program has approximated that of the network as a whole. For instance, in June 1978 during the second special observing period, 28 of Australia's 47 buoys were operational, compared with 181 out of 293 for the complete network.

Use and Impact of Buoy Data

Although the primary purpose of the buoy network was to provide a data set for research purposes, it was expected that the observations would be received in time for real-time analysis operations. In practice the Bureau was able to use the buoy data as an input for its WMC analyses and to carry out post analyses updating of its RMC and NMC analyses.

As an associated and necessary part of these analyses, the network was subjected to quality monitoring with a view to exposing buoys providing data consistently in error. Such buoys were listed in a quality monitoring bulletin which was transmitted to the Buoy Control Centre at Toulouse. (The quality monitoring of sea surface temperature data was carried out in real-time but it was not possible to summarise results from mid 1979 due to lack of resources.)

The buoy observations resulted in a marked and consistent improvement in the accuracy of the analyses and prognoses carried out at Melbourne and resultant forecasts by the Regional Forecast Centres.

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The Director, of Meteorology,
Department of Science and the Environment,
Melbourne.

A REVIEW OF THE FGGE BUOY SYSTEM
AND POSSIBLE FUTURE SYSTEMS

* R.S. de la Lande

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Director of Meteorology,
Department of Science and the Environment
Melbourne

INTRODUCTION

The Southern Hemisphere Drifting Buoy System which is one of the major special observing systems established for the First GARP Global Experiment (FGGE) also known as the Global Weather Experiment is a basically new type of surface observation system which has been used routinely from its inception late in 1978 to provide a data set from the data sparse ocean areas of the southern hemisphere for FGGE research and for real time analysis and forecast operations. Whilst the scientific evaluation of the buoy data set will take considerable time its use in real time analysis and forecasting operations by the Bureau of Meteorology has already resulted in a marked and consistent improvement in accuracy.

The development of the system has required a major co-operative program by the participating countries, which include Australia, in the short space of two years from late 1976.

OBJECTIVES

During the FGGE year now current from 1 December 1978 to 1 December 1979 the entire global atmosphere and sea surface is being observed in detail for the first time to establish a data set for research purposes. The buoy data by enabling observations from the data sparse southern hemisphere ocean areas is critical to the success of FGGE. Its data, when used with complementary satellite derived observations, permits the detailed specification of the distribution and structure of weather systems in these areas for research and operational purposes.

Requirements as stated by WMO (GARP Implementation-Operations Plan Vols 1 and 5 1978) are for –

Atmospheric Pressure: Range 920 to 1048mb, accuracy + 1mb and resolution 0.5mb with measurements preferably time averaged over a period of 60 seconds (Maximum update interval 15 minutes).

Sea Surface Temperature: Range −5°C to 35°C, + 1°C accuracy and resolution 0.2°C.

Observations of the above quality were required at least once and preferably twice daily from a network of 1000km spacing in the southern hemisphere oceans between 20° and 65° south latitudes. The network was to be at peak effectiveness during each of two Special Observing Periods SOP1 (5 January – 5 March) and SOP2 (1 May – 30 June).

The actual implementation plan developed by the Committee of Participants provided far more frequent observations than the basic requirement described above.

* Bureau of Meteorology,
Department of Science and the Environement,
Melbourne

ORGANISATION

The direction and co-ordination of the overall buoy project was carried out by a Committee of Participants for the Southern Hemisphere Drifting Buoy System. Its membership comprises representatives from the contributing nations shown below, functional entities i.e. Service Argos and the Logistics and Deployment Centre, and WMO. Functions of the Committee, which reports to the GARP Activities Office of WMO, include the setting of buoy standards, the acceptance of buoys as FGGE platforms and provision of advice and direction to the functional entities. The main participating contributors are as follows (buoy quantities are as offered in 1978):

Argentina:

Deployment of 26 FGGE buoys

Australia: *

50 buoys . Level II—a data quality monitoring for all FGGE buoys in Southern Hemisphere.

Deployment of FGGE buoys.

Canada:

80 buoys, Logistics and Deployment Centre, secondment of an expert to FGGE Operations Centre/Data Processing and Control Centre.

Chile:

Deployment of 26 FGGE buoys.

France:

35 buoys, Data Processing and Control Centre. Deployment of FGGE buoys.

New Zealand:

10 buoys. Deployment of FGGE buoys.

Norway:

55 buoys. Deployment of FGGE buoys.

U.K.:

9 buoys. Deployment of FGGE buoys.

U.S.A.:

50 buoys. Deployment of FGGE buoys.

The above offers total 289 buoys. The actual number of buoys contributed was greater in some cases bringing the total to 301.

* Bureau of Meteorology, Department of Science and the Environment.

OPERATIONAL SYSTEM

The operational system comprises the network of buoys, a data collection location and associated processing system provided by France and known as the Argos System, buoy data monitoring and quality control programs and a number of data dissemination systems the latter including the Global Telecommunication System (GTS) through which the Australian Bureau of Meteorrology receives buoy observations four times daily for use in its real time operational programs and an associated buoy data quality monitoring program covering all buoys in the network. The concept of operation of the system is illustrated in Figures 1 and 2.

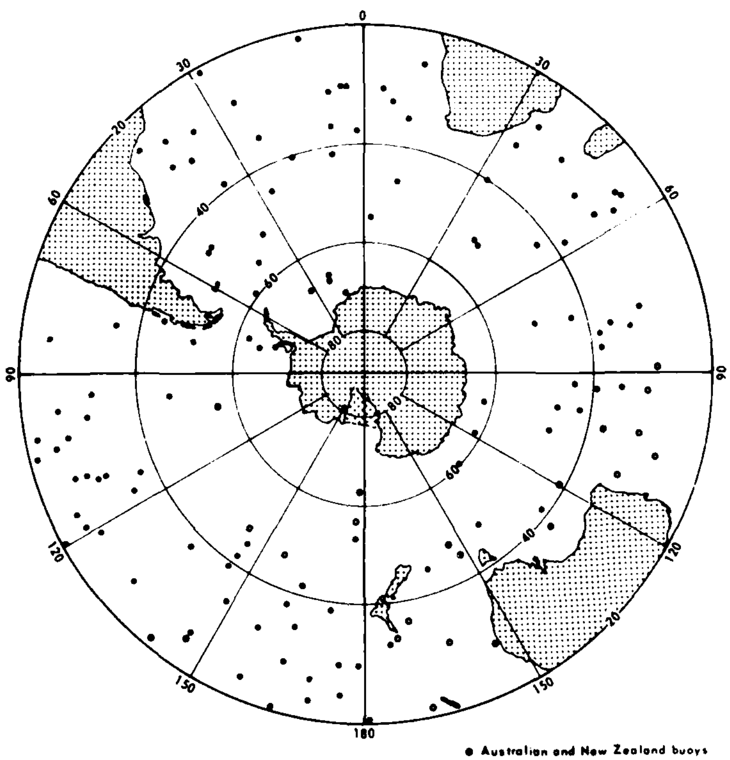

Fig.1 Distribution of FGGE drifting buoys south of 20°S Latitude on 31 August 1979

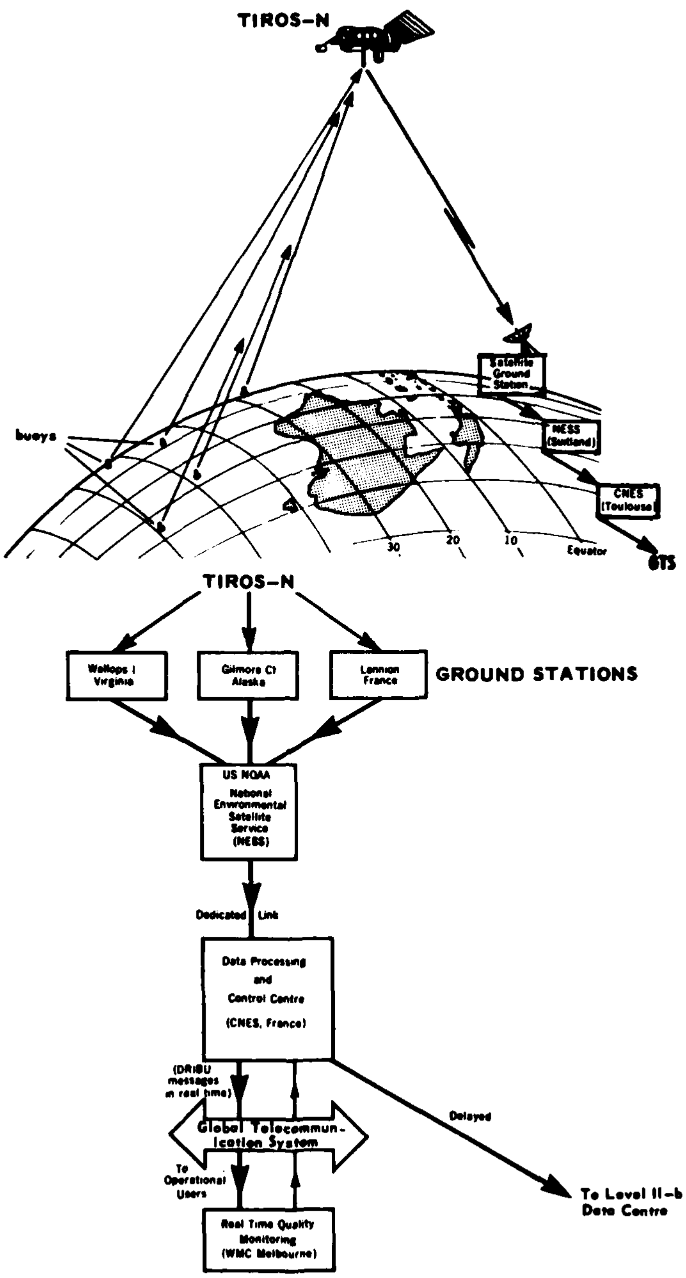

Fig. 2 System concept. (Second satellite not shown)

The FGGE buoys although differing in design were developed for compliance with the WMO observational requirements given earlier in this paper. Each buoy in the network is equipped with a low power (2 watt) UHF radio transmitter to transmit its identification code, raw sensor data and some engineering data at intervals present in the range 40 to 65 seconds under the control of an internal timer forming part of the buoy electronics system. There is no intended transmisssion synchronisation between the transmissions of buoys in the network. These unsynchronised (i.e. random) transmissions from buoys within range are received by the Argos data collection and location equipment carried on each of the United States Tiros-N and NOAA-A.

Satellites operating in sun synchronous orbits at a height of about 850km with a period 101 minutes. Each buoy in the network between 20° and 65° is within range of one of these satellites (and thus has its data collected) between 6 and 21 times daily depending on the latitude of the buoy.

Buoy location is determined from measurements of the doppler shift in buoy transmission frequency as measured by the satellite during its pass together with a precise knowledge of the position and velocity of the satellite at any instant of time during the time that the satellite is within radio line of sight of a buoy. An ambiguity between the real and an image position produced by this technique is resolved by reference to the previous buoy position or by comparing results from successive passes.

The buoy data received by satellites is recorded on board and read out later in the orbit to one of three ground receiving stations located at Wallops Island (Virginia), Gilmore Creek (Alaska) and Lannion (France). It is then passed via the U.S. National Environmental Satellite Service to a Data Processing and Control Centre in Toulouse in France where within about three hours of its collection by the satellite the raw data from the buoys is processed into forms suitable for transmission to real time users and also for subsequent delayed mode processing and quality control. The processing includes the computation of buoy location and the conversion of raw sensor data into physical values. The latest available observation from each of the operational buoys in the network is transmitted by the Toulouse Centre into the GTS at 6 hourly intervals (corresponding to the standard WMO synoptic times) for real time operational users including the Melbourne World Meteorological Centre (WMC).

The latter centre also carried out the quality monitoring of the buoy data from the whole network in conjunction with operational usage. Buoys whose pressure reports don't consistently fit the analysis field to within 4mb are regarded by the Melbourne WMC as having a faulty pressure channel and are reported to the Buoy Central Centre at Toulous. Faulty sea surface temperature is reported in a similar way. Although not used for real time operations sea surface temperature reports are also quality monitored in Melbourne.

Buoys reporting both faulty pressure and sea surface temperature data are regarded as non-operational and their data are (or should be) excluded from dissemination by the GTS to avoid the consistent entry of faulty observations into meteorological analysis.

Delayed mode processing of the buoy data received from every pass is carried out by the Buoy Control Centre at Toulouse to produce a quality controlled data set known as a Level 11b data set. This includes the results of quality monitoring by the Melbourne WMC. Every month the quality controlled data are transferred on magnetic tape to the Level 11b Spaced Based and Special Observing System Data Centre in Sweden, where together with observational data from other sources it will be subjected to further quality control measures to ensure a complete reliable data set for research.

FGGE BUOYS

The essential characteristics of the types of buoys produced for FGGE are given in Table I. All are powered by primary batteries of between 50 and 100 ampere hour capacity to give an operational endurance of 9 to 18 months depending on the type of buoy. A critical feature is the pressure sensor exposure system. Except for the Australian buoy all employ an exposure system employing a dessicant to absorb any moisture which penetrates past a primary water trap. The Australian buoys use a Bureau designed labyrinth filter as a water barrier (Jesson E.E. and McKenzie R.J. 1975).

The sensitive pressure sensors used in the buoys are typically of the aneroid strain gauge or aneroid quartz crystal oscillator type. Temperature sensors are typically of the thermistor type. The electronic systems make maximum use of low power consumption integrated circuits to carry out the internal timing,sensor interfacing analogue to digital conversion and multiplexing functions necessary in each design. All transmitters and associated circuitry (known as Platform Transmit Terminals (PTT) are specifically designed for use with the Argos system and must be type certified before use.

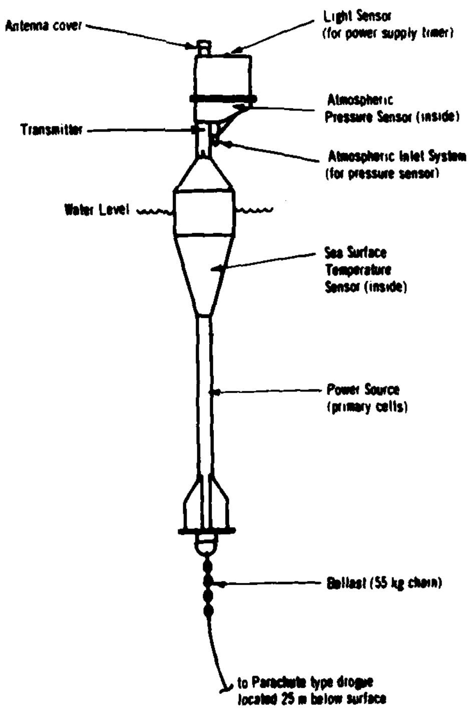

Fig. 3 Australian Drifting Buoy

The buoy data transmissions (on a frequency 401.65 MHz) contain sensor values plus and other reference or compensatory values (e.g. temperature of pressure sensor) necessary for the conversion, as part of the Argos processing at Toulouse, of these values into meteorological observations. For this purpose each buoy producer has to supply the Argos Centre with calibration function information for each individual buoy.

Figures provided by the Buoy Control Centre (Preliminary report April 1979) reveal a failure rate of 14% within 10 days of deployment for the network as a whole. It is probable that this was due to deployment hazards and "infant mortality" in buoy sub-systems which effected some type of buoy more than others. Of the 25 Australian program buoys still operational at the end of August 1979, 15 have been in service for 8 months or more. (Corresponding figures for the network as a whole are not available at the time of writing).

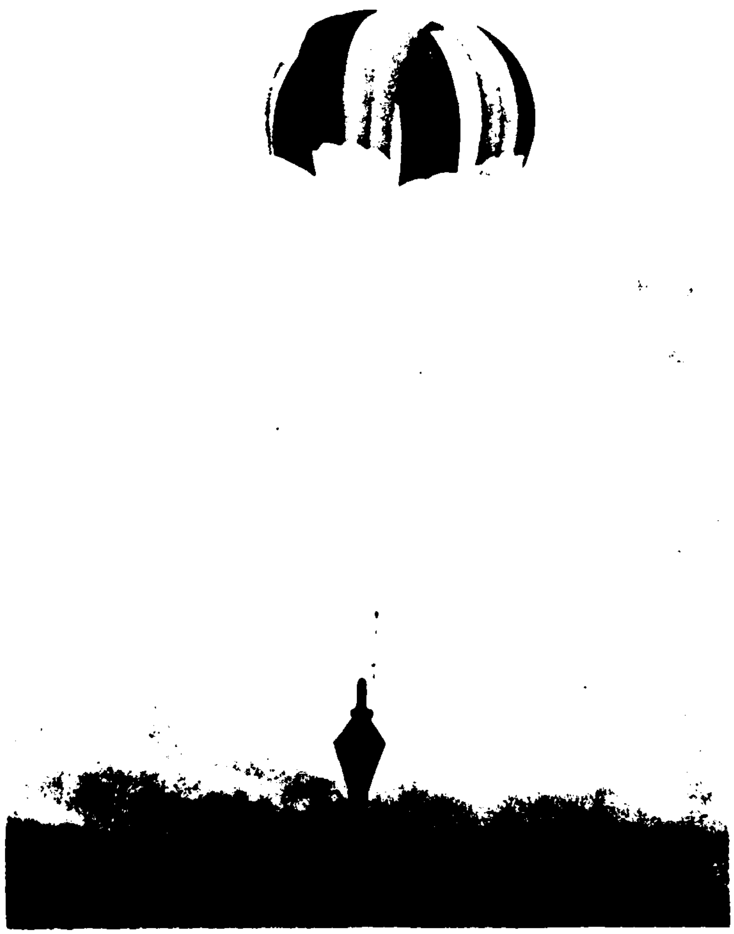

Fig.4 Parachute deployment of United States FGGE type buoy.

Table 1 : Characteristics of FGGE Buoys

Producer	Type	Length m	Max. Diameter	Weight kg	Drogue	Pressure Transducer
Australia	Spar with flotation collar	4.8	0.60	155*	at 25m depth	Gilmore/MB Electronics EBA 300
Canada	Spar	1.9	0.50	100	None	Paroscientific Digiquartz 230A
France	Spar with flotation collar	2.7	0.54	100	None	Ceram, Mod. Cap 130
Norway	Spar with flotation collar	2.4	0.80	70-80	on 2/3 of the buoys at 12.5m depth	Aneroid Fuess-capsule
U.S.A.	Spar with flotation collar	3.1	0.69	93	None	Paroscientific Digitquartz 215A/002
U.K.	Spar with flotation collar	1.9	1	100	at 20m, 100m or 300m depth	Paroscientific Digiquartz 230A
	Discus	1.5	1.5	150	None	Paroscientific Digiquartz 230A

* includes external ballast chain and drogue, 50kg.

DEPLOYMENT OF BUOYS

Almost 300 FGGE buoys were deployed using scientific, Antarctic supply, navy and numerous merchant ships. Late in the deployment program (May 1979) following the availability of parachute deployable buoys in the United States, 15 were deployed by NOAA using USAF Starlifter (C141) military aircraft. Buoys provided by France, Norway and the United States were in most cases deployed by dedicated vessels. Australian, Canadian and New Zealand's buoys relied more on the use of co-operative merchant vessels which carried out the deployments as an incidential part of their normal operations. Australia's 47 buoys involved 22 vessels for their deployment.

The essential part played by the above vessels in making the buoy network possible is noted with appreciation.

The deployment of buoys for SOP1 was slightly behind schedule with 125 deployed by the starting data of 5 January. Of these 106 were satisfactory (28 Australian buoys had been deployed by this stage with 24 satisfactory). Table 2 illustrates the growth and status of the network through to August 1979.

The development of the deployment plan commenced early in 1977 following the establishment of the Logistics and Deployment Centre by Canada and the availability of data regarding numbers of buoys available and offers of deployment by participating countries. Working closely with the latter countries this centre developed the overall plan finally used. Where feasible (such as for Australia) areas of deployment responsibility were established to decentralise detailed planned and implementation.

Problems experienced during the Australian deployment program included difficulties in communicating comparison measurements taken by deployment ships as part of the checking procedure prior to deployment, the temporal co-ordination of such comparison reports with the buoy observations (the timing of the latter depends on satellite pass times), the lack of easily understood quantitative test equipment for use on the deployment ships and deployable problems under rough sea conditions in the case of the relatively large Australian buoy. The latter problem was anticipated but was unavoidable in view of the essential need to use a buoy hull already operationally proven. Information is not available about problems experienced by the other participants.

Table 2 : FGGE Buoys South of 20°

Date	Number Launched	Number with Good Pressures	% of area within 500km of good buoy
1 Nov. 78	13		
1 Dec.	31		
1 Jan.	117	101	
(5 January – 5 March)			
5 Jan. 79	125	106	52%
15 Jan.	147	126	64%
29 Jan.	174	143	70%
12 Feb.	189	161	67%
28 Feb.	198	156	59%
5 Mar.	204	152	65%
SOP2 (1 May – 30 June)			
30 Apr.	252	173	70%
11 May	268	182	74%
14 May	277	189	–
21 May	283	200	79%
28 May	289	203	80%
5 Jun	296	206	81%
11 Jun.	297	200	81%
18 Jun.	297	191	78%
25 Jun.	301	195	77%
2 Jul.	301	192	–
30 Aug.	301	148	–

OPERATIONAL PERFORMANCE OF SYSTEM

A post launch comparison by the Buoy Control Centre of ship and buoy pressure measurements taken within one hour of deployment reveals a standard deviation of 1mb. A corresponding comparison of ship and buoy sea surface temperature measurements is not possible however the same source reports an agreement within +1°C early in the deployment program between buoy and satellite derived measurements in cases where this was possible. A Bureau analysis of immediate post deployment pressure data from Australian buoys suggest a standard deviation of presssure errors of less than 1mb.

Bulletins containing the latest available report from each buoy are received in Melbourne approximately 6 hours after each synoptic hour (00, 06, 12 and 18Z). Because of communication problems between a satellite read out ground station and the Argos System Centre at Toulouse the 06Z bulletin typically contains very few 06Z observations. With this exception the buoy observations arrive in time for the WMC analyses and although too late for RMC and NMC analyses they are used very profitably for post analysis updating.

Because of the delay in launching the second satellite (NOAA-A) the synoptic observation period of geographical coverage achieved for each of the synoptic hours (00Z, 06Z etc) was less than expected up to the end of June when NOAA-A was launched. This aspect is covered in a separate paper (Guymer L.J. 1979).

Because of drift and buoy attrition (failures) and an inability to deploy in some areas because of a lack of shipping the required network spacing of 1000km was not achieved throughout the network. However good results were achieved by mid SOP1 when 70% of the area was within 500km of an operational buoy. By mid SOP2 the corresponding figure was 81%. At the end of August 1979 148 (49%) of the 301 buoys deployed between December and early June were still fully operational (200 of the 301 buoys were deployed prior to March). One type (French) had 67% still operational.

Position determination by the Argos system based on results on land were generally within the 2km quoted in the Argos documentation (Argos Users Guide March 1978 Edition).

FUTURE BUOY SYSTEMS

It is expected that the present FGGE network will progressively expire due to battery exhaustion and radom component failures by mid 1980. The Argos system will continue using the United States Tiros−N, NOAA-A and their successors through to 1985 at least. However at the time of writing there are no known plans for a continuing buoy network in the southern hemisphere. Because of administrative planning and production times the establishment of a regional network of say 20 buoys by Australia would involve a lead time of about two years from approval. This would probably apply also to other potential participants. A multi national co-operative network such as currently existing will require coordinated planning to ensure optimum cost effectiveness.

For meteorological purposes the observations provided by a buoy network would be required within two hours of the synoptic hour for most effective use in the Melbourne NMC's real time operations. The present centralised data collection, processing and dissemination system inherently requires longer time which although acceptable for Melbourne WMC operations cannot provide data in time for the NMC operation. Direct read out stations can resolve this problem at least out to their limit of range (understood to be approximately 2000km for location and sensor data and 3000km for sensor data only). These stations operate by receiving and decoding the continuous data broadcast by the satellite whilst the latter is within range during its pass. The satellite broadcast includes buoy data as received for all buoys within range of the satellite. One such facility is planned for Melbourne and a later one for Perth. Fortunately buoys within range of these stations would usually be the ones from which the timely receipt of data would be most important. The addition of a station in the Antarctic e.g. at Casey and another in New Zealand would provide real time coverage over most of the area between 70° East and 180° longitudes south of latitude 20°S.

Experience with the FGGE network indicates that buoy types suitable for use in future buoy networks already exist however in most cases adjustments to improve reliability and operational endurance would be worthwhile. The latter aspect is significant because experience suggests that buoys which survive the first few months of life will last until theiir batteries are exhausted. The addition of a redundant power system such as a solar type could extend this lifetime indefinitely.

The Australian type buoy can be readily developed to incorporate a wind direction sensing capability and the desirable longer lifetime feature mentioned in the previous paragraph. Any new type of meteorological buoy developed by Australia should be capable of deployment by aircraft (the feasibility of deployment without parachute should be considered) and from ships in motion. It should also have the other essential characteristics of long lifetime, reliability accuracy and low cost. The system design should include as alternative options a drogue and a continental shelf type fixed mooring. For regional networks at least it is desirable that buoys drift as little as possible. The concept of using deep multi level drogues for this purpose should be investigated.

Based on the successful FGGE experience the deployment of an Australian regional network (e.g. between 70°E and 180° latitudes) appears feasible using co-operative merchant and government ships as an incidental activity to their primary missions. However for a reasonably complete year round network in the high latitudes deployment by aircraft would be necessary. Similar remarks apply for the rest of the hemisphere however there may be a number of difficult locations in the South East Pacific and South Atlantic oceans which could require dedicated ships.

To overcome the communication problem mentioned earlier deployment ships should be supplied with a data transmission unit employing the Argos system for the transmission of the independent comparison observations taken by the ships crew prior to or immediately after a buoy is launched. Such observations and the buoy data transmissions would thus usually be collected by the same Argos system satellite and appear in the same obsevational report received by the operational meteorological agency responsible for the buoy.

CONCLUSIONS

The FGGE buoy system has been implemented and has performed close to its design objectives to produce a marked and consistent impact on operations. The system demonstrates that an ongoing network would be viable as a routine observational system. Some system improvements are however desirable to enhance effectiveness and economy.

ACKNOWLEDGEMENTS

The author wishes to acknowledge with appreciation the dedicated work of the many members of the Bureau of Meteorology who at various times have been engaged on the implementation and operation of the Australian portion of the FGGE Southern Hemisphere Drifting Buoy System. Thanks are also due to the Atmospheric Physics Division of CSIRO for the valuable and dedicated support given for FGGE buoy data quality monitoring and the Antarctic Division for the deployment of numerous FGGE buoys. Also to the Fisheries and Oceanography Division of CSIRO for their valued advice regarding drogues and hulls for the Australian program.

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Fig 5 Australian FGGE drifting buoy

Fig.6 Canadian FGGE drifting buoy

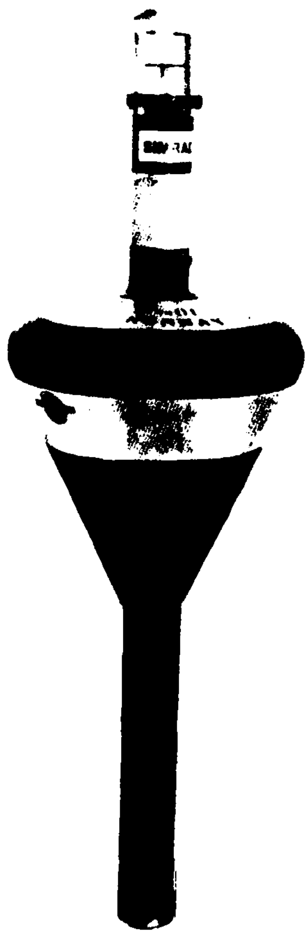

Fig.7 Norwegian FGGE drifting buoy

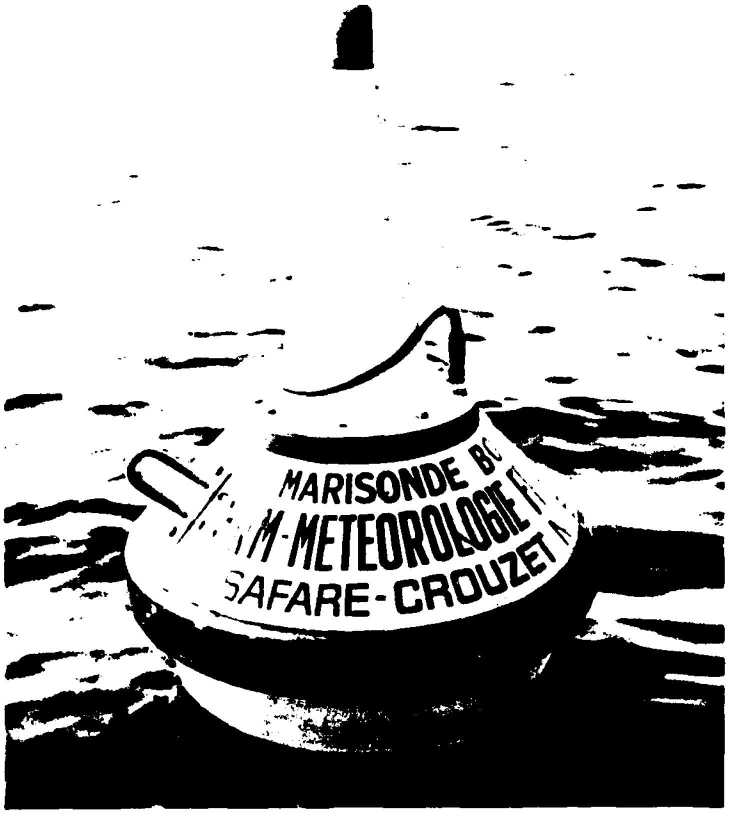

Fig.8 French FGGE drifting buoy

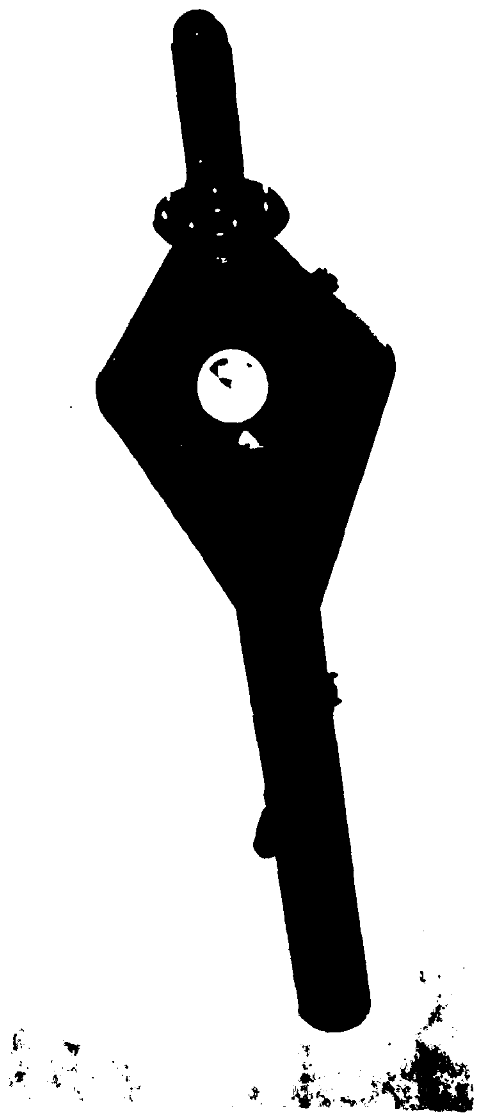

Fig.9 United States FGGE drifting buoy

AUSTRALIAN OCEANOGRAPHIC RESEARCH PROJECTS

Resource Management Section,
Fisheries Division,
Department of Primary Industry,

This department does not directly undertake oceanographic research. However it will be attempting to correlate available oceanographic data with the information held by the section on fish catches from joint ventures, feasibility studies and foreign fishing vessels.

Projects include:

1. Collection and compilation of log book data from fishing vessels in the Australian Fishing Zone (AFZ).
2. Analysis of this data to determine the standing stock and total allowable catch.
3. Determination of major fishing grounds and/or correlating fish catches with environmental variables such as temperatures, bottom topography etc.

Other projects are undertaken on an **ad hoc** basis in answer to specific queries and needs.

Data collected during fisheries research projects funded or supervised by the Fisheries Division is sent to C.S.I.R.O. Division of Fisheries and Oceanography for processing and archiving.

Royal Australian Navy Research Laboratory

The purpose of this laboratory is to investigate the physics of environmental factors relevant to the conduct of naval warfare in waters of interest to Australia. The aim is to construct models of various physical processes which can be incorporated into prediction schemes.

Projects include:

1. Analysis of Heat Capacity Mapping Mission (HCMM) satellite pictures to relate these images to fronts and eddies.
2. Studies of eddy formation in the Tasman Sea.
3. Theory and experiments on transient thermoclines.
4. Measurements on oceanic micro-bubbles.
5. Formation of radar ducts.
6. Laboratory modelling of the surface mixed layer.
7. Analysis of currents, temperature profiles and other oceanographic variables in Bass Strait from ESSO-BHP platform (Coastal Oceanography).
8. Stability of the base of the surface mixed layer via Richardson No. profiles.

Future projects include:

1. Marine sediment mapping
2. Studies of the Sub Tropical Convergence.

RANRL holds a variety of data types including XBT records, Nansen casts and STD profiles. Most of this data is stored on magnetic tape.

Department for the Environment, South Australia

This department aims to conduct baseline physical studies and monitoring programmes in Gulf St. Vincent.

Projects include:

1.	Wave studies		to develop energy distribution for the South Australian coastline – initially in the upper Spencer Gulf.
2.	Current Studies	(a)	To determine the mixing and dispersive properties of the Adelaide nearshore waters using radar tracked lagrangian buoys and fixed current meters.
		(b)	Offshore Monitoring Programme. A programme to measure temperature, salinity, water quality in the South Australian Gulfs and approaches. Presently confined to stations on Neptune Island and Investigator Strait. Co-ordinated by the South Australian Marine Advisory Committee and conducted by the State Department of Fisheries and C.S.I.R.O.
3.	Sediment Studies	(a)	Beach profiling in Metropolitan and country districts.
		(b)	Vibrocoring sampling in Metropolitan area.

Future projects include baseline biological and chemical studies in South Australian Gulfs.

This department holds data on beach profiles, current speed, and direction, temperature and salinity for parts of its area of interest. Data on sand reserve areas in the Metropolitan district and bottom sediment mechanical and chemical analysis has been sent on to other organisations.

Public Works Department – Victoria,
Ports and Harbours Division.

The Investigations Section supplies advice on coastal matters appertaining to the Division and as such operates a hydraulic model laboratory as well as undertaking all forms of field studies.

The research undertaken is almost entirely applied research aimed at solving specific problems. For example, harbour design, beach nourishment, environmental studies and encompasses all physical oceanographic phenomena.

Projects include:

1. Port Phillip Coastal Study – a data collection, evaluation and assimilation study of physical phenomena.
2. Corio Bay Hydrodynamics – evaluation of water movement and circulation.

Future projects include environmental studies on the Gippsland lakes region and a hydrodynamic study of Westernport Bay.

Data held by the Section covers all physical coastal phenomena (waves, winds, tides, currents, sediments etc.) and is stored on computer in the form of magnetic tapes.

PRESSURE TRANSDUCER CABLE FOR WAVE MEASUREMENT IN SURF ZONES

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Abstract

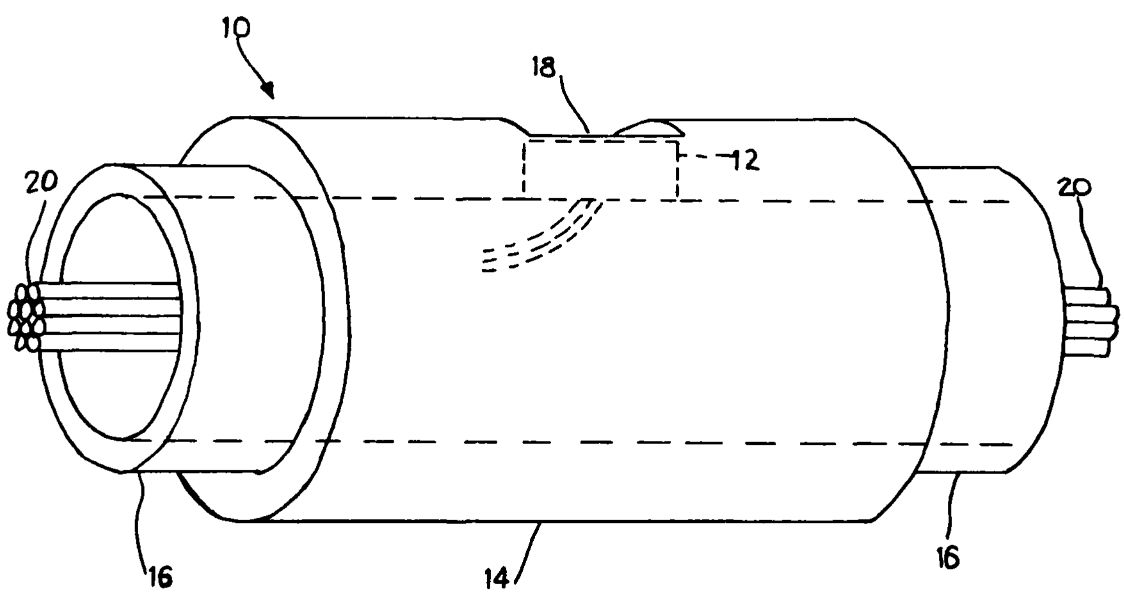
This device relates to a system and method for measuring the spatial and temporal variation of waves in a fluid, and in particular to the measurement of the maximum amplitude of waves in a surf zone.

Description

In surf-zone-tests an important quantity to be measured is the maximum surf or wave height. The wave height normally increases from a constant value offshore, reaches a maximum prior to breaking and then vanishes at the high water line on the beach. This measurement cannot be accurately made with a single fixed probe since it is unlikely that the probe will be located precisely at the point where the waves reach their maximum amplitude. Further, surface-piercing electrical resistance type wave gauges currently in use will not perform correctly for plunging or spilling breakers. Trapped air pockets in the breakers cause such resistance gauges to register readings lower than the actual wave height, and water splashing above the free surface of the wave causes the gauges to register readings higher than the actual wave height.

Referring to the Figure, the present system utilize a pressure transducer cable 10 comprising a series of pressure transducer units 12 (one shown) encased in rigid connectors 14 and spaced along a length of flexible tubing 16. The pressure transducer unit 12, comprising a pressure transducer and an amplifier, is located beneath a recessed diaphram 18 at the exterior of the rigid connector 14. Pressure data is relayed to monitoring equipment on shore via data transmission lines 20 which run through the interior of the flexible tubing 16. The pressure transducers are spaced approximately 100 feet apart in shoaling wave regions and farther apart in deep water regions.

In operation, the transducer cable is anchored offshore and lies on the bottom along a line perpendicular to the shoreline. The output of each pressure transducer is recorded as a function of time, and wave height is calculated from the measured pressure after correction for the mean depth of the transducers. The mean depth is determined from the transducer output during relatively calm water periods. Should the cable become mired in bottom sediments, or should inspection or repair become necessary, the cable can be raised by pumping air into the flexible tubing.



Advantages and Features

An advantage of the pressure transducer cable system is that more accurate measurements of surf zone wave height can be taken than with single, fixed, electrical resistance type wave gauges. This system enables the increasing wave amplitude to be plotted as the wave approaches the shoreline.

Deployment and retrieval of the system may be simplified by the attachment of a buoy to the cable anchor and by the use of a cable storage drum.

For further information, contact:

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